ENGINEERING SOILS MAP OF UNION COUNTY, INDIANA

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Joint Highway Research Project

by

A.K. TURNER

PURDUE UNIVERSITY
LAFAYETTE INDIANA

Progress Report

[illegible]
of
UNION COUNTY, INDIANA

TO: Dr. [illegible] A. Leonards, Director
Joint Highway Research Project

November 28, 1967

File: [illegible]

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-51G

The [illegible]
County, [illegible]
detailed [illegible]
The [illegible]
A. [illegible]

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Progress Report

ENGINEERING SOILS MAP
OF
UNION COUNTY, INDIANA

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A. K. Turner

INTRODUCTION

Development of an engineering soils map of Union County was the primary goal of this project. The map is appended to this report; the report supplements the engineering soils map information.

The detailed pedological soils maps published in the 1960 "Soil Survey of Fayette and Union Counties" by the United States Department of Agriculture (7) were the single most important source of data used in the project. These agricultural soils map sheets, at a scale of 1:15,840, were assembled to form a mosaic map of Union County. Careful study of the soil series descriptions enabled the grouping of the series into appropriate landform and parent material categories. Preliminary landform and parent material boundaries were then delineated on the mosaic-map.

Routine airphoto interpretation techniques supplemented the pedological data. Aerial photographs were examined and the preliminary boundaries checked and modified, if necessary, to produce final landform and parent-material boundaries. The photographs were contact prints at an approximate scale of 1:20,000. Date of photography was 1940.

Published geologic reports were studied to verify and amplify the soils information. Most important of these were the reports of Dr. Ansel M. Gooding, Department of Geology, Earlham College, Richmond, Indiana (2,3,4). He has made detailed studies of the glacial deposits in this

area. His report on the terraces along the Whitewater River (2) contains much detailed information beyond the scope of this report.

The final landform and parent-material boundaries were graphically reduced to produce the engineering soils map. Symbols were used to delineate the parent materials (grouped according to landform and origin). Textural symbols were then superimposed to indicate the relative compositions of the parent materials. The map also includes a set of soil profiles which indicate the general soil profiles of topographically high and low sites in each parent material area. Each profile shows the general range in depth and texture (USDC textures) of each soil horizon. Because of the obviously bad construction characteristics of highly organic top-soils, these materials were carefully mapped. However not all of the identifiable areas of these materials were large enough to be shown on the relatively small scale engineering soils map.

DESCRIPTION OF THE AREA

General Nature of the County

Union County is located in southeastern Indiana. The Indiana-Ohio state line forms the county's eastern boundary (Figure 1). The county has a north-south length of approximately 14 miles, a width of 12 miles, and a total area of 168 square miles (6). Liberty, the county seat, is centrally located within the county about 65 miles east-southeast of Indianapolis, and reports a 1960 population of 1,745 out of a total county population of 6,457 (6). The county is predominantly agricultural and about 90 percent of the land is farmed (7). Agriculture is mainly concerned with the raising of livestock, chiefly hogs. Thus considerable

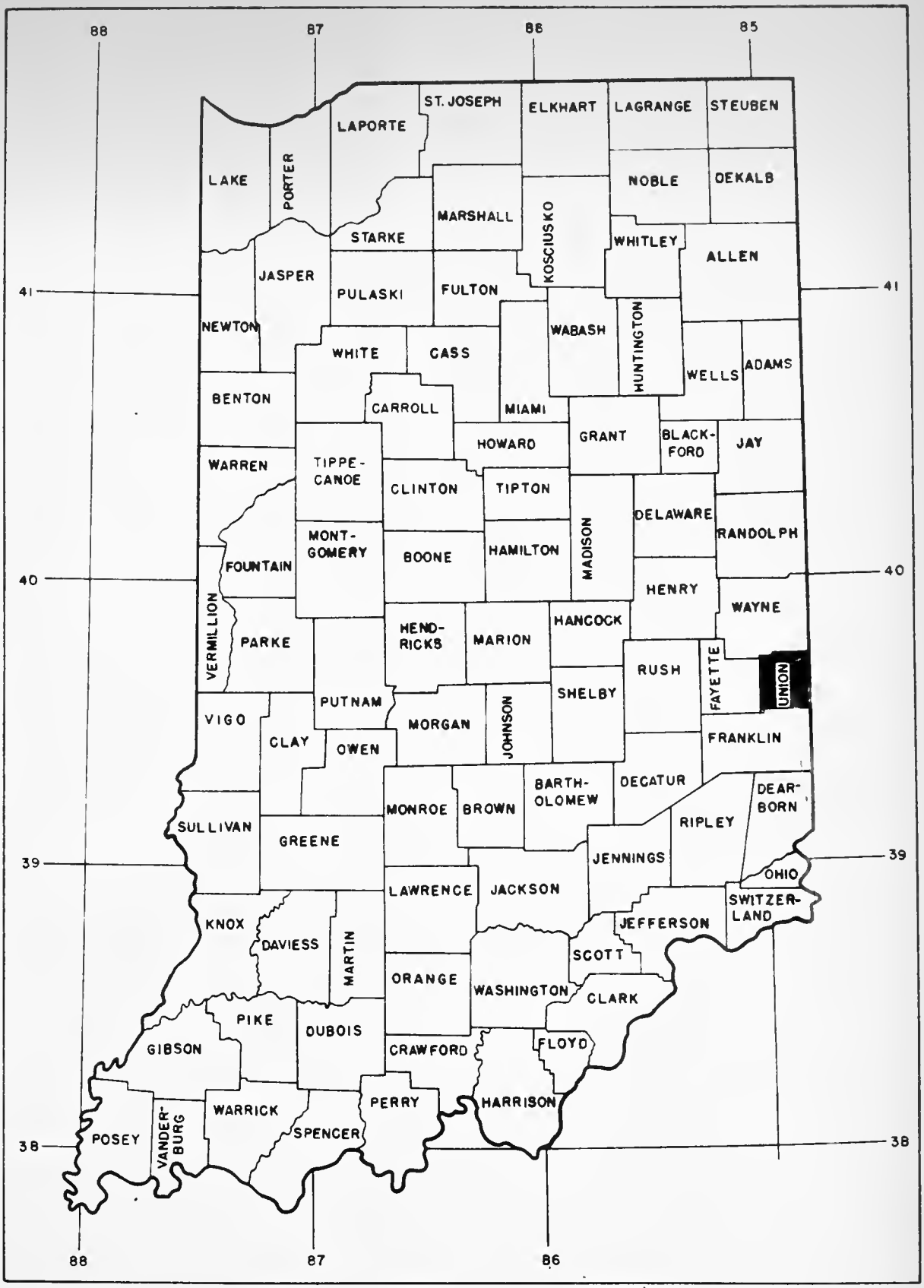


FIGURE 1

LOCATION MAP OF UNION COUNTY

cleared land, and much woodland, is devoted to pasturing; while forage crops, especially corn, hay, and wheat, are the main crops (7).

Climate

Table 1, derived from the Agricultural Soil Report summarizes temperature and precipitation data obtained at Rushville, Indiana, and believed typical of Union County conditions (7).

Union County has a continental type of climate with erratic temperature changes within and between seasons. The winters are moderately cold; the summers warm and humid. Analysis of the mean monthly temperatures shows the county to have a freezing index of 192 degree days. Yoder (11) shows that this might indicate a frost penetration of 20 inches in a well-drained non-frost-susceptible base course. The winter season is particularly marked by rapid temperature changes. Commonly periods of two or three days of subzero weather are followed by short periods of warm weather. As a consequence damage from freezing and thawing of highway subgrades can be expected.

Rainfall varies from season to season. Heaviest rains occur in the spring; flooding of the Whitewater River is common.

Physiography, Topography, and Drainage

Union County lies within the Till Plains Section of the Central Lowland Province (1,10). However, since the glacial drift is comparatively thin over most of the county Malott (5) has included the county within the northern portion of the Dearborn Upland physiographic region of the State.

Elevations in the county range from a low of about 750 feet in the southwestern part where the East Fork Whitewater River leaves the county, to a high slightly in excess of 1,100 feet, found in the northeastern parts of the county. Figure 2B gives a general picture of the topography.

TABLE 1

Temperature and Precipitation Data for Union County*

Month	Temperature (°F)			Precipitation (inches)		
	Mean	Extreme High	Extreme Low	Mean	Extreme Dry	Extreme Wet
Jan.	28.7	70	-26	3.39	0.71	12.06
Feb.	29.9	71	-23	2.83	0.32	8.31
Mar.	39.9	86	-13	3.96	0.04	12.08
April	50.4	91	14	3.69	0.90	9.11
May	61.3	96	26	4.10	0.53	8.46
June	70.2	101	35	3.93	0.71	8.45
July	74.2	103	40	3.33	0.20	7.96
Aug.	71.6	103	36	3.15	0.29	9.64
Sept.	62.3	101	22	3.38	0.17	9.36
Oct.	54.4	93	12	2.83	0.23	9.11
Nov.	41.3	82	-10	3.17	0.37	9.23
Dec.	31.6	68	-21	2.97	0.48	6.14
Annual	51.5	103	-26	40.73	0.04	12.08
Number of years of records	67	75	75	77	77	77

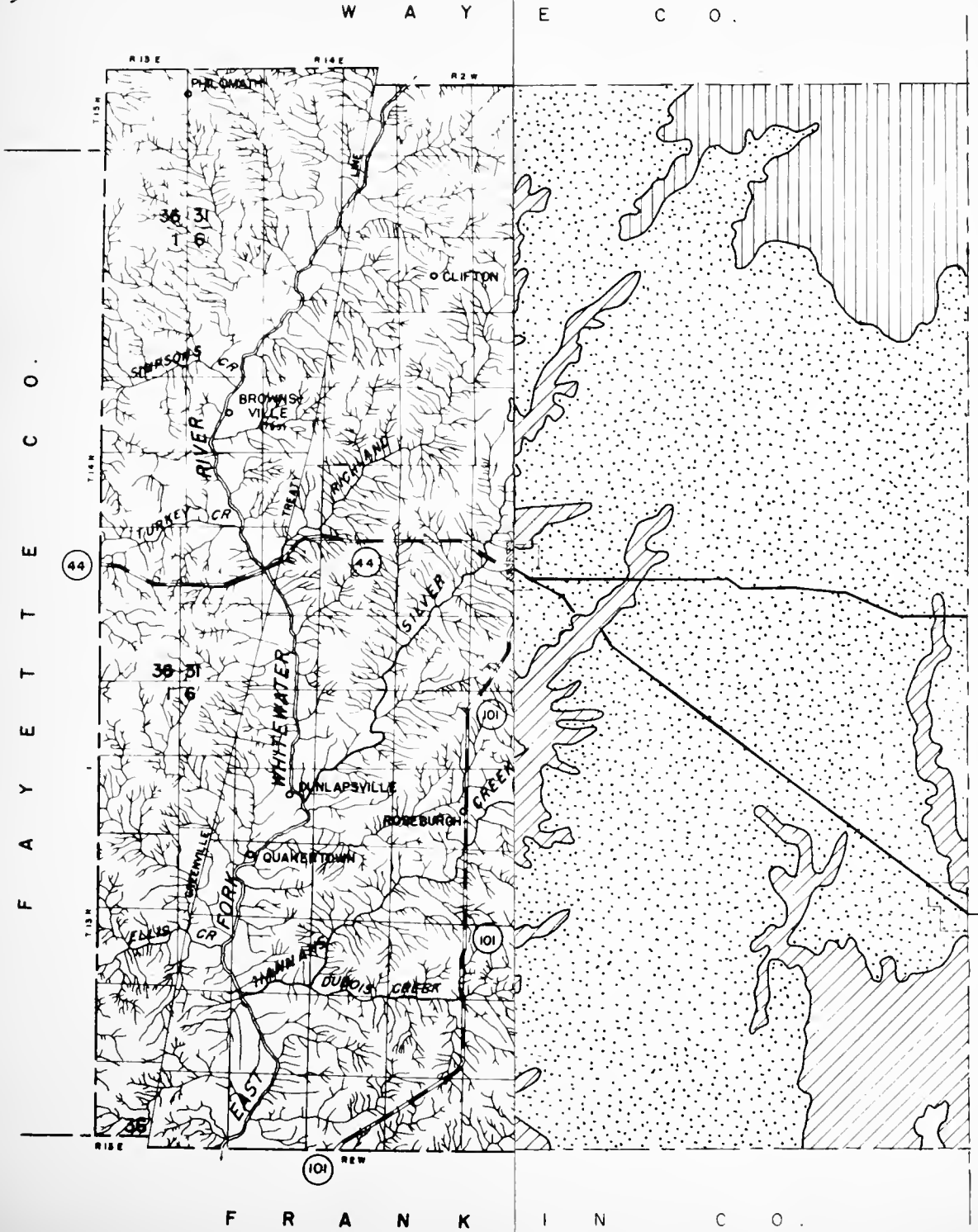
*This data obtained from Agricultural Soil Survey of Fayette and Union County by USDA. The recording station was at Rushville, Indiana, in Rush County, since 1948; prior to 1948 the station was at Waldron, Indiana. Rushville station location is Lat. 39° 36'N.; Long. 85° 27'W. ground elev. = 953 feet.

PREPARED FROM
1940 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJEC
AT
PURDUE UNIVERSITY
1946

SCALE OF MILES
1 3/4 1/2 1/4 0 1 2 3 4

FIGURE 2B

TOPOGRAPHIC MAP
UNION COUNTY
INDIANA



PREPARED FROM
1940 AAA AERIAL PHOTOGRAPHS
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JOINT HIGHWAY RESEARCH PROJECT
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PURDUE UNIVERSITY
1946

FIGURE 2A

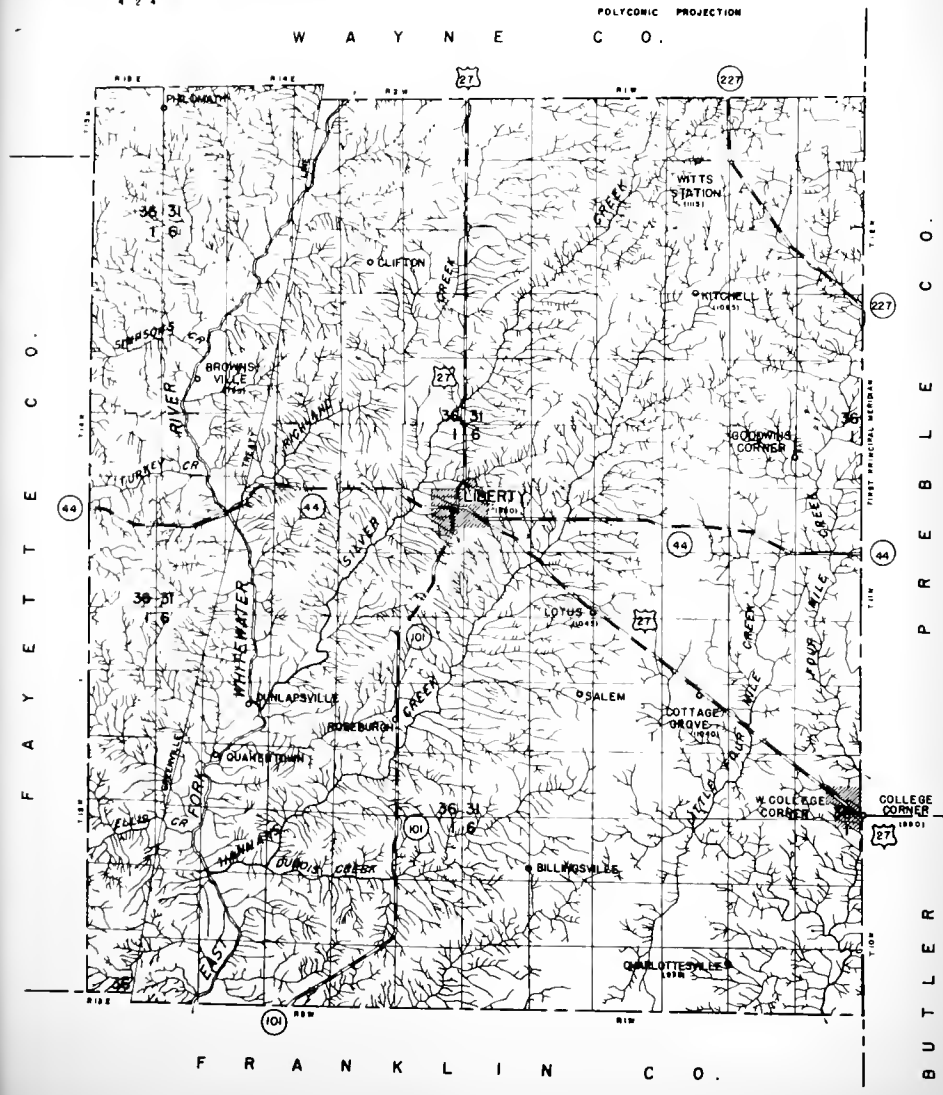
DRAINAGE MAP

UNION COUNTY

INDIANA

SCALE OF MILES

POLYCONIC PROJECTION



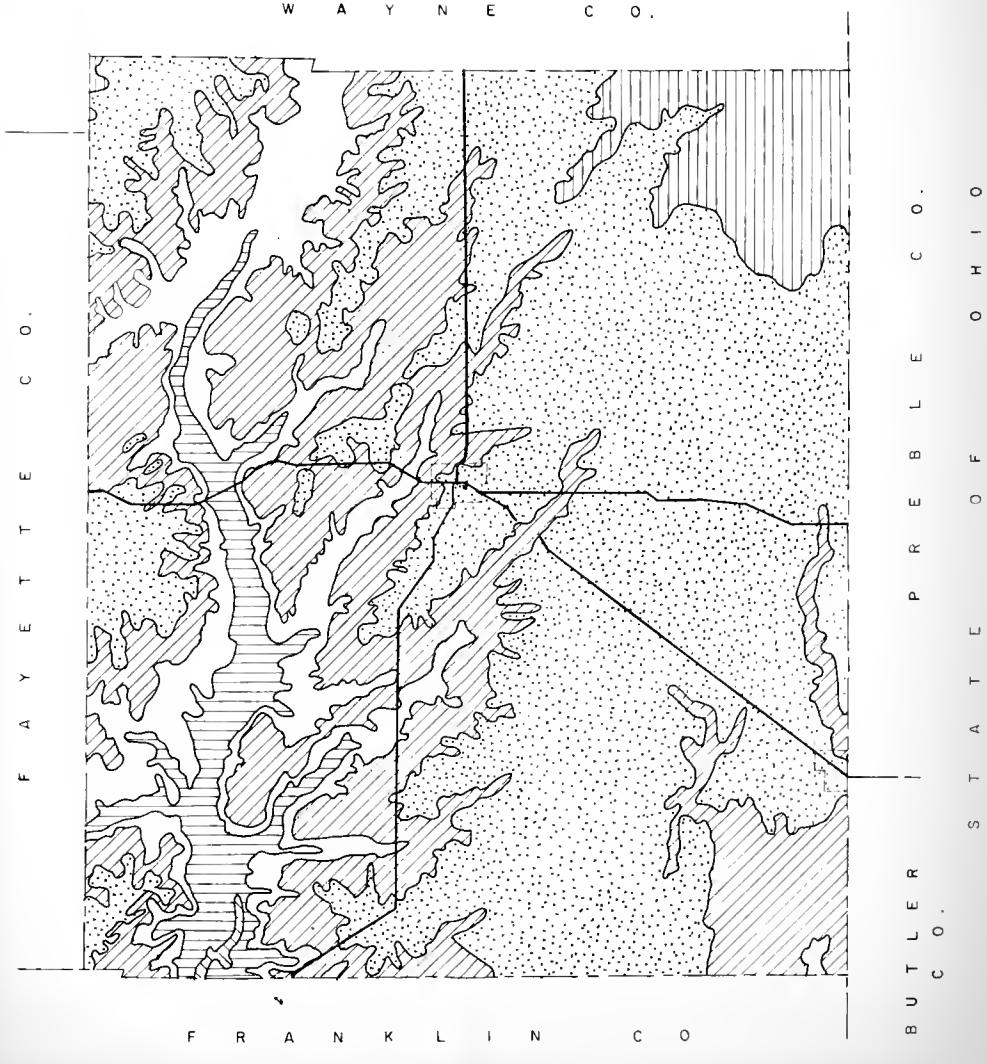
(CONTOUR INTERVAL 100')

FIGURE 2B

TOPOGRAPHIC MAP

UNION COUNTY

INDIANA



The present topographic surface is that of a glacial plain conforming somewhat to the irregularities of the underlying bedrock surface. The originally smooth upland surface has been considerably dissected by the East Fork Whitewater River and its several tributaries. All of the larger streams are bedrock controlled. As a consequence their valleys are quite narrow with steep walls and local relief approaches 400 feet in the southwestern parts of the county near the East Fork Whitewater River. The valley of the East Fork Whitewater River is much narrower than the valley of the West Fork in adjacent Fayette County and the terraces, while numerous, are generally of small areal extent and are interspersed with erosional rock benches.

The East Fork Whitewater River is the trunk stream for three-quarters of the county. Major tributaries are Dubois, Hannahs, Silver, Richland, Simpson, Turkey, and Ellis Creeks. Eastern portions of the county drain into the Ohio since Four Mile Creek is part of the Miami River system. Figure 2A shows the county drainage system.

Geology

Bedrock Geology

Most of the county is underlain by bedrock of Ordovician age; however the northeast corner is underlain by Silurian rocks. Limestone and interbedded limestone and shale are the common rock types. Rock outcrops are restricted to stream beds, terrace faces and valley walls. All major streams are bedrock controlled and rock is commonly encountered along the East Fork Whitewater River and its major tributaries.

Glacial Geology

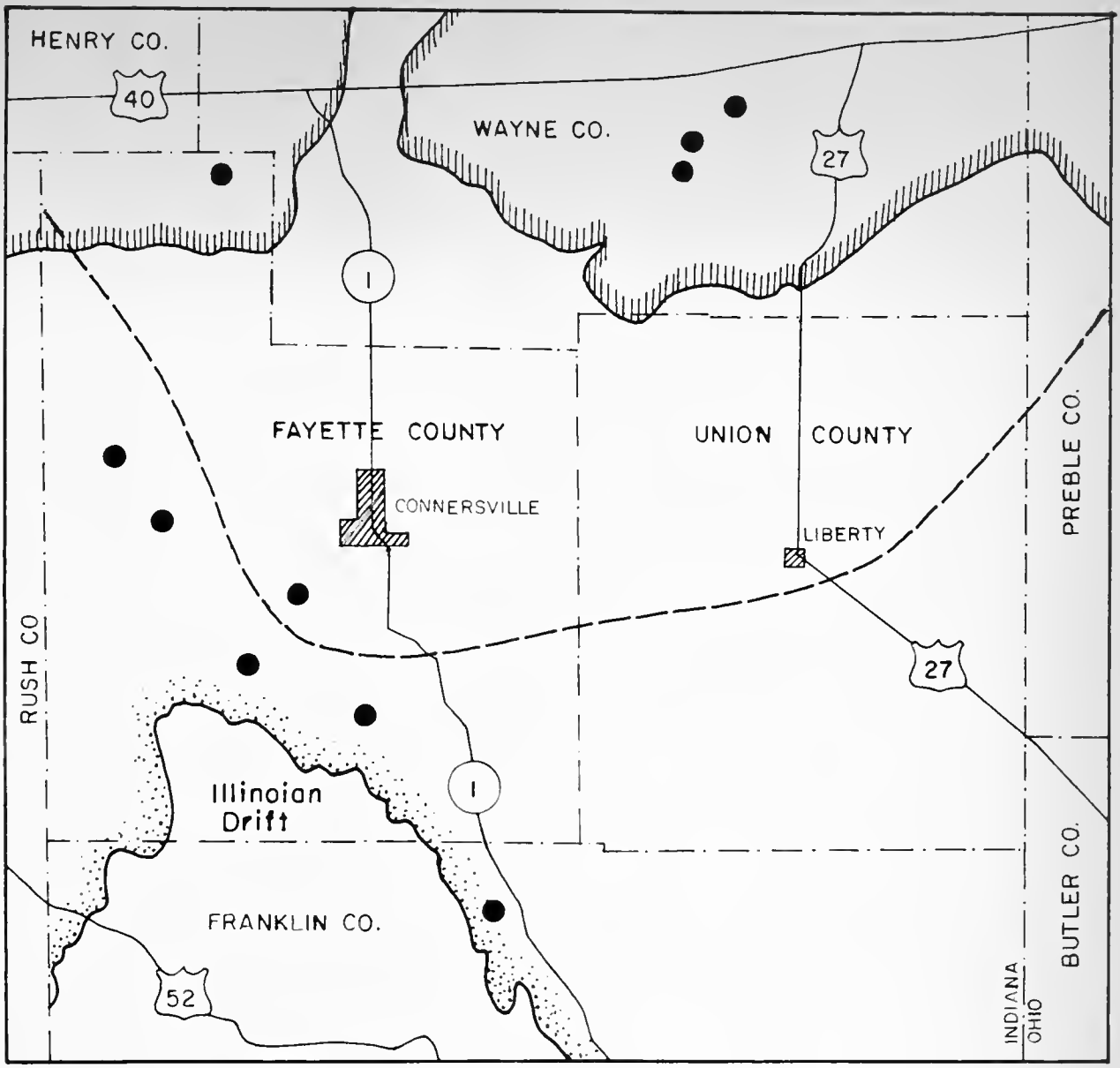
Union County has been extensively glaciated by the earlier Illinoian and the later Wisconsin ice sheets. Each of these ice sheets advanced

and retreated several times; the Illinoian ice sheet probably advanced and retreated at least three times in this area (3). Consequently three Illinoian tills, separated by outwash gravels and sands or eolian silts have been identified at depth in this area (3,4). No large areas of Illinoian drift are exposed in Union County; however these deposits underlie much of the more recent Wisconsin drift and may be exposed in creek valleys or deep excavations.

At least two different Wisconsin advances affected parts of Union County. The first advance covered the northwest half of the county, as shown in Figure 3. A distinctive red-brown "Whitewater till" has been found in excavations in adjacent areas and is believed to underlie part of Union County also (3,4). A new glacial advance over-ran the entire county and "Shelbyville" drift from this glacier now covers most of the county, except where it has been removed by subsequent erosion.

Melt waters from later glacial advances formed a complex series of terraces which are now found along the East Fork Whitewater River and some of its tributaries. Gooding (2) has identified six levels and related these to the various glacial advances. For engineering purposes a two-fold division, into "high" and "low" terraces, appears adequate. The higher terraces are older than the lower terraces, and therefore have different origins. It is thus not surprising that the terrace levels have somewhat different parent materials--the upper terraces are composed of a silt cover overlying sands and gravels; the lower terraces are generally more variable, their compositions ranging from sand and gravel to sand and silt. The lower terraces lack a consistent silt cover common to the upper terraces.

The upland till surfaces are covered with a layer of wind-blown silt, or loess, one to five feet thick, which was probably derived from the



Legend

"Champaign" Drift Boundary

"Shelbyville" Drift Boundary

Buried Early Wisconsin Till Boundary ("Whitewater Drift")

Highway

County Line

Location of Sections Described by Gooding

FIGURE 3

MAP SHOWING LOCATION OF WISCONSIN DRIFT BOUNDARIES IN FAYETTE AND UNION COUNTIES

(after A. M. Gooding 1961, 1963)

valley outwash deposits. The accompanying engineering soils map differentiates areas where this loess cover is approximately three or more feet thick.

There are no eskers in Union County; however there are a few kames. These are located mostly on the west side of and close to the East Fork Whitewater River valley.

LANDFORMS AND ENGINEERING SOIL AREAS

Landforms

Union County contains a variety of landforms. Three major categories are easily recognized. They are as follows:- 1) slightly dissected Till Plains of Early Wisconsin age, 2) River Terraces, and 3) Flood Plains. There are also several minor landforms, including loess, mounds, kames, and small outwash plains associated with old glacial spillways.

The six different terrace levels described by Gooding (2) have here been grouped into two types:- high terraces which are generally 20-35 feet above the flood plain and consequently are well-drained and low terraces which are generally only 5-15 feet above the flood plain and are usually poorly drained. Also, as previously mentioned, the composition of the terraces materials is generally different; the high terraces normally consist of gravel and sand, overlain by silty sands, while the low terraces are more variable, varying in composition from sand and gravel to sand and silt.

Interspersed with the terraces are a series of rock benches. These generally conform in elevation with nearby terraces but are composed of only a thin layer of sand and gravel over a bedrock core. It is possible that some of the areas mapped as terraces also contain bedrock cores at somewhat greater depths than those areas mapped as benches.

Engineering Soil Areas

The soils of Union County can be divided into four major groups which reflect their origins:- a) Glacial deposits, b) Fluvial deposits, c) Eolian deposits, and d) Miscellaneous deposits. These can be further subdivided by landform and parent materials into a number of distinctive units as shown on the engineering soils map and as listed in Table 2. Table 2 also shows the relationships between these landform-parent material

TABLE 2

ORIGIN	LANDFORM	PARENT MATERIAL	SOIL SERIES
GLACIAL DEPOSITS	Wisconsin ground moraine	[illegible]	[illegible] Zenia, Russell, [illegible]ain, Celina
	[illegible]	[illegible]	[illegible] Rodman
FLUVIAL DEPOSITS	Terraces [illegible]	[illegible]	[illegible] Miami Fox), Rodman
	[illegible]	[illegible]	[illegible] on scarps; (minor [illegible], Martinsville
	Flood Plains	[illegible]	[illegible], Ithaca, Ross, [illegible], Sloan
EOLIAN DEPOSITS	Dunes	[illegible]	[illegible]ock, Reesville
LACUSTRINE DEPOSITS	Plains	[illegible]	[illegible] Miami, Fyne
	Depression	[illegible]	[illegible]ston, Kokomo

subdivisions and the soil series names employed by the pedologists in mapping the soils of Union County (7).

A) GLACIAL DEPOSITS

Most upland areas in the county are covered with Wisconsin ground moraine overlain by a thin loess layer. A few kames are found in the western part of the county.

Ground Moraine - Silty Texture

Most of these soils have some wind-blown silt on the surface. This serves to greatly increase the silty texture of the near surface horizons, and in places reaches five feet thick. Areas where this silt deposit is over three feet thick have been mapped as separate loess areas.

The silt cover has tended to smooth the rolling topography so that uneroded areas are quite level. However areas near the East Fork Whitewater River and its major tributaries have been considerably dissected so that little level topography remains. In contrast, the eastern third of the county, which is farthest removed from the river, is much more level.

In the smooth eastern areas the upper portions of the soil profile are very silty; the lower portions of the profile are silty clays or clays. The A-horizon may be a foot thick and is usually a silty loam or silty-clay loam. The B-horizon is normally a silty clay and the C-horizon a clay or silty clay.

In the western two-thirds of the county extensive areas of steep slopes occur due to dissection by the many creeks and gullies. In these areas very thin soil profiles are found overlying interbedded limestone-shale bedrock. The entire profile may be as little as a foot deep with a silty textured A-horizon a few inches thick, and a B-horizon of silty

clay extending down to about 12 inches. Where rock is so very close to the surface flat slabs of limestone are common throughout the soil profile.

Kames - Sandy and Gravelly Texture

Kames are not very common in Union County; however a few are found in the western part of the county near the East Fork Whitewater River valley.

The depths and compositions of the various soil profile layers are quite variable. Frequently the A-horizon may be a silty, sandy, or even clayey loam. The depth of the A-horizon ranges from a few inches to perhaps a foot. The underlying B-horizon ranges in composition from silty clay to sandy clay or gravelly clay and may extend to depths of about three feet. The underlying parent material is sand and gravel, sometimes with small amounts of intermixed or interbedded silt and clay.

B) FLUVIAL DEPOSITS

Extensive fluvial deposits are found along the East Fork Whitewater River and along the lower portions of its many small tributaries. Small outwash plains and terraces are found along the abandoned glacial sluiceways in the western part of the county. The East Fork Whitewater River exhibits a well-defined flood plain, or alluvial plain, and the many creeks exhibit proportionately broad flood plains.

Terraces - Sandy and Gravelly Texture

The terraces along the Whitewater River and its tributaries are generally composed of sands and gravels. These terraces are most extensive in the northern part of the county, north of Brownsville. However small terraces are common along all the tributaries of the East Fork Whitewater River in the western half of the county.

Two terrace levels can be distinguished. The upper level terraces occur from 20 to 35 feet above the flood plain. These terraces normally have a silty sand cover about three feet thick overlying the sand and gravel. Accordingly the A-horizon can be classified as a silty loam and is often a foot thick. The B-horizon gradually changes from a silty clay to a sandy or gravelly clay with depth. Below about five feet sand and gravel (C-horizon) is encountered.

The lower terraces occur from 5 to 15 feet above the flood plain and normally lack the silt cover so common on the upper terraces. The A-horizon is usually a foot thick and is generally a loam. The B-horizon rapidly grades downward into a sandy or gravelly clay and rarely extends below three feet. The underlying parent material is stratified sand and gravel, or sand and silt, and is quite variable.

Associated with the terraces are several rock benches. These conform in topographic position with nearby terraces. However they are composed of shallow veneers of sand and gravels, probably less than ten feet thick, overlying limestone-shale bedrock, and thus differ from terraces which are composed entirely of granular materials.

Alluvial Plains - Sandy, Gravelly, Silty, Clayey Texture

The alluvial plains shown on the map include the flood plains of the various rivers and creeks and so can be considered as subject to seasonal flooding. These areas are of recent origin, being formed largely from the sediment moved by the water in time of flood. As a consequence these deposits vary greatly from place to place. The top soil varies from loam to silt loam, with some areas being more sandy. In any one area rapid changes from loam, to sandy loam, to silty loam or silty clay loam can be expected. Stratification can be expected in some places. Within the

gravelly material within three feet.

C) EOLIAN DEPOSITS

Loess deposits are the only eolian or wind deposited materials occurring as mappable units in Union County.

Loess Mounds - Dissected

Most of the [illegible] is covered by a thin layer of olive-brown silty [illegible] this silty layer [illegible] contains a concentration of [illegible] usually entrapped at least [illegible] the upper limit of each loess deposit. [illegible] between the Firebaugh- Bonfield [illegible] and the Fayette-Orion-Russell soil series.

This silt deposit [illegible] feet thick in Union County and are [illegible] The [illegible] is about one foot thick and [illegible] loam [illegible] and [illegible] are also silty loams which [illegible] to a depth of the loess deposit. The base of the loess deposit is marked by an abrupt change to [illegible] Wisconsin till.

D) MISCELLANEOUS

Several areas of highly organic soils have developed in depressions and poorly drained areas in the uplands in the eastern third of Union County. There are also several areas in the county where bedrock is at or near the surface. These [illegible] are grouped under miscellaneous deposits.

Highly Organic Deposit

Highly organic topsoil is found in depressions or other areas where drainage is retarded. Such areas are most commonly found in the Wisconsin ground moraine in the eastern part of the county. This area is relatively distant from the East Fork Whitewater River valley and as a consequence stream erosion has not yet increased the local relief so that the natural drainage is slow. In general, these deposits are not deep in Union County and thus should not pose major construction problems. However these areas should be carefully field checked to determine the amount of material to be removed during construction.

Bedrock Benches and Valley Walls

Bedrock is found at or near the surface on one or both sides of the East Fork Whitewater River valley along its entire length in Union County. Bedrock is also found in the valley walls of all major tributaries. As mentioned previously, bedrock-cored rock benches are interspersed with terraced in the Whitewater valley. Thus bedrock can be encountered at shallow depths at many locations in the western half of the county.

The bedrock consists of interbedded limestones and shales. The limestone tends to be thinly bedded and thus where exposed to weathering and erosion often produces talus slopes of slabby limestone intermixed with shale fragments. The bedrock is subject to landslides in deep excavations if slope and drainage are not controlled.

Up to ten feet or more of granular materials may overlie bedrock on the upper surfaces of the rock benches. However their scarps and the valley walls where bedrock is exposed will have very shallow soil profiles as little as a foot deep. These profiles may have non-existent or poorly

defined soil horizons and will often contain fragments of slabby limestone throughout the profile. The channels of all small creeks in this area are covered with small blocks of flaggy limestone.

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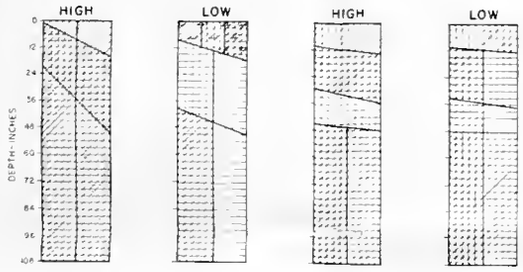
GENERAL SOIL PROFILES

GLACIAL DEPOSITS

WISCONSIN DRIFT

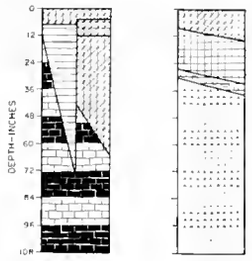
RIDGE MORAINE — HIGH | LOW

GROUND MORAINE — HIGH | LOW



THIN DRIFT LIMESTONE-SHALE

KAMES



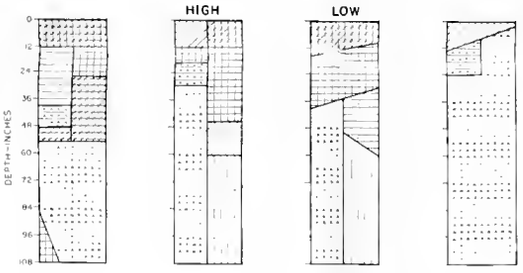
FLUVIAL DEPOSITS

TERRACES

HIGH LEVEL — HIGH | LOW

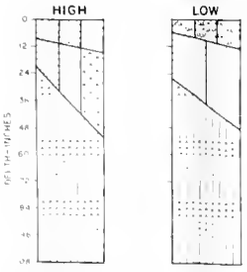
LOW LEVEL — HIGH | LOW

SCARPS



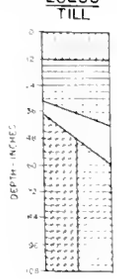
FLOOD PLAIN

HIGH | LOW



EOLIAN DEPOSITS

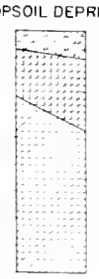
LOESS TILL

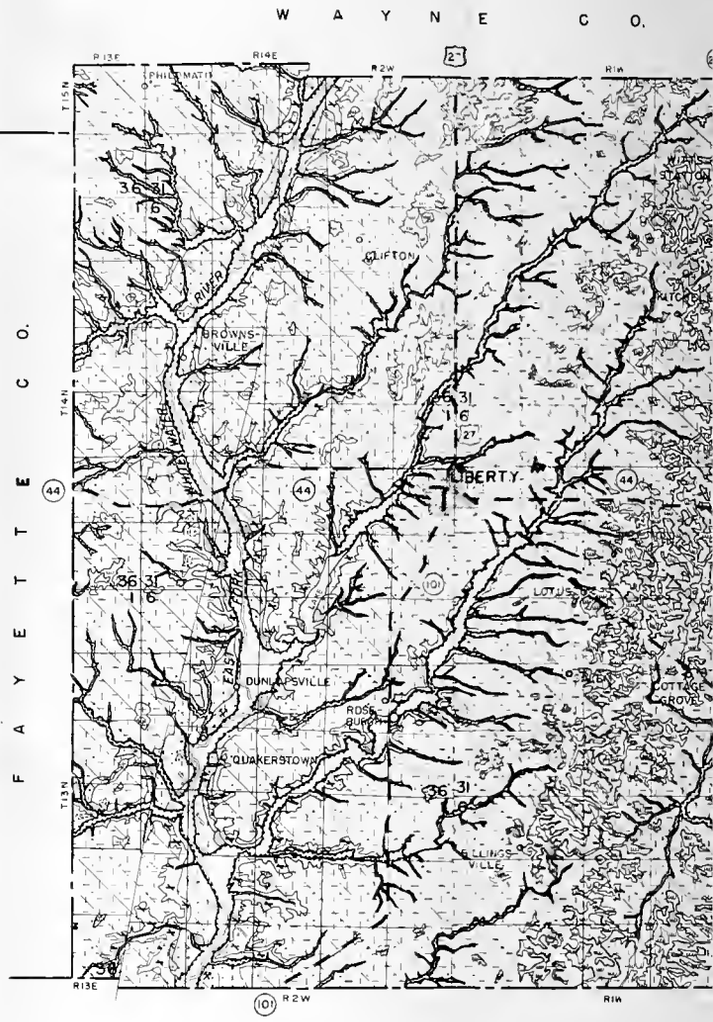


MISCELLANEOUS DEPOSITS

LIMESTONE-SHALE

HIGHLY ORGANIC TOPSOIL DEPRESSION





ENGINEERING SOILS MAP

UNION COUNTY

INDIANA

PREPARED FROM

1940 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

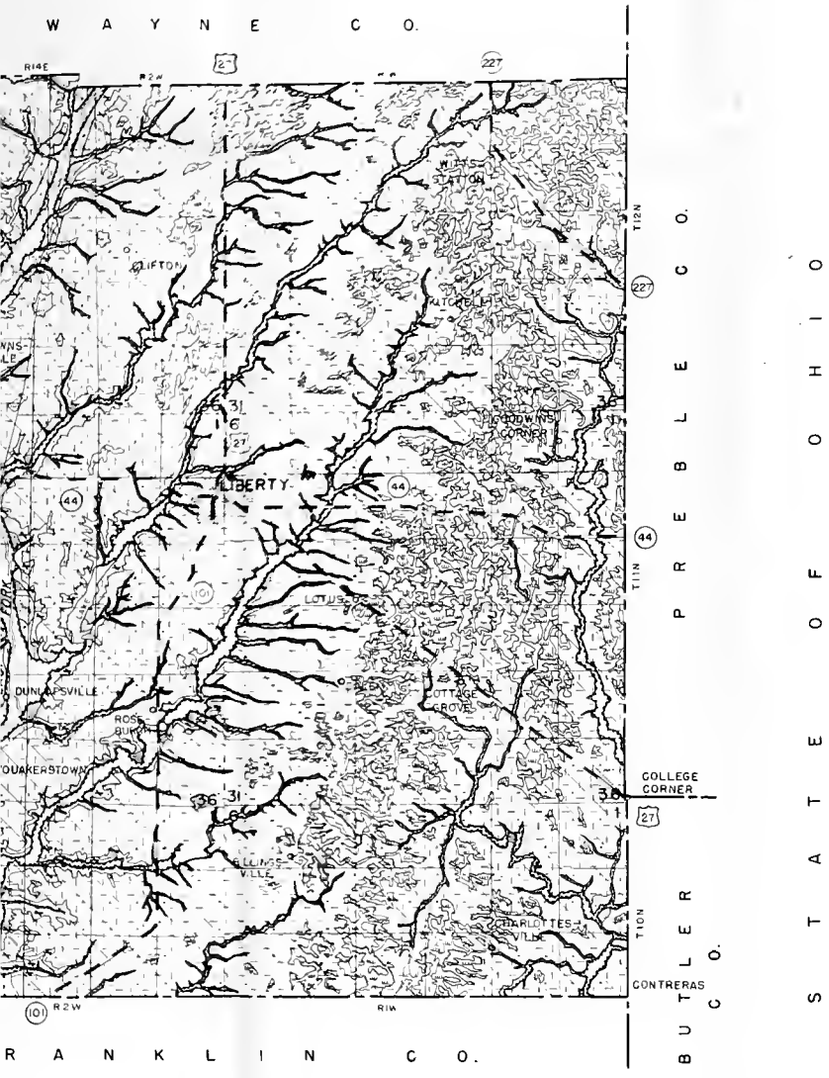
PURDUE UNIVERSITY

1967

SCALE OF MILES

1 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF [illegible]



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INDIANA

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SCALE OF MILES
1 1/2 1/4 0 1 2 3 4

LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- WISCONSIN GROUND MORAINE
- THIN DRIFT ON LIMESTONE–SHALE
- TERRACE
- ROCK BENCHES
- FLOOD PLAIN
- LIMESTONE–SHALE
- LOESS MOUND

MISCELLANEOUS

- GRAVEL PIT
- HIGHLY ORGANIC TOPSOIL
- KAME

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL SYMBOLS TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

TEXTURAL SYMBOLS FOR SOIL PROFILES

- GRAVEL
- SAND
- SILT
- CLAY
- LOAM
- STONY
- ORGANIC MATTER
- LIMESTONE
- SHALE

POLYCONIC PROJECT ON

DRAWN BY: Y K TANG AND T Z HALBO